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AUTHOR Shipe, Ron; And Others
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ABSTRACT

A study examined the development and implementation of an interactive video instruction system for teaching electronics and industrial maintenance at the University of Tennessee. The specific purposes of the study were to document unusual problems that may be encountered when this new technology is implemented, suggest corrective actions, and propose a model for implementing interactive videodisk systems. One unique problem encountered during the system's introduction was the problem of ownership and the limitations for making revisions. Also, since the decision to implement the video system was an administrative one, many faculty members felt that the system was being forced on them. A four-phase model for introducing interactive videodisk technology was developed. The four phases are as follows: initiation (the stage leading up to and including the decision to adopt the change); implementation (the initial incorporation and use of the new technology); continuation (the phase where change gets built into the ongoing program); and outcome (the stage in which a summative evaluation of the system's effectiveness is conducted). One of the most important factors in successful implementation of interactive video systems is that administrators have an adoption time perspective rather than an implementation perspective. (MN)

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A CASE STUDY: IMPLEMENTING AN INTERACTIVE VIDEO INSTRUCTION SYSTEM IN TEACHING ELECTRONICS AND INDUSTRIAL MAINTENANCE

Presenters

Dr. Ron Shipe
Project Manager
Skills Development Department
Tennessee Valley Authority

Dr. Gerald Cheek
Professor & Head
Department of Technological & Adult Education
The University of Tennessee

Dr. Roger Haskell
Professor
Department of Technological & Adult Education
The University of Tennessee

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Introduction

Since society is moving through a transitional period from the industrial age to the information age, the demands on education and training accelerate. Although new knowledge is increasingly available, better mechanisms are required for organizing and presenting that knowledge so individuals can assimilate and apply it.

Education and training, due to rapidly changing technologies, can no longer escape the fact that technologies are invading the domain of instructional methodology. Today two specific technologies have come together to form a unique and powerful tool for educators and instructors. The first technology is the video laserdisc and the second is the computerization through microelectronics. The union of these technology systems is referred to as the interactive laser videodisc instruction.

Laserdisc Research

One of the biggest roadblocks to using videodisc technology is the lack of meaningful conclusions from research. James Bosco notes in an issue of Educational Technology, that the perception of scarcity of evaluation reports may be a consequence of the difficulty in getting access to them.

Professional trainers are attracted to interactive video because of the flexibility of the technology and its wide range of application and program design (Strauss and Lentz).

Advanced Systems Inc., has gathered many studies on the use of interactive videodisc instruction, documenting the performance benefits claims of interactive training over other methods of training. These studies show that, overall, costs to the client are directly impacted through the reduction of initial and remedial training time (Strauss and Lentz).

When using interactive delivery methods instead of other instructional methods, learners can cover course materials more rapidly. Unlike classroom students, interactive video learners are not locked into a specific linear instructional sequence, and can skip over material they already know or have mastered (Strauss and Lentz).

"In a study conducted at the U.S. Army Signal Center, practice with actual equipment was compared to videodisc simulations. The videodisc group mastered the skills in 25 percent less time." W. D. Ketner, Conference on Videodisc for Military Training and Simulation, Society for Applied Learning Technology (Strauss and Lentz).

"Digital Equipment began training workers with interactive video several years ago. Delbert Lippert (former Vice President, Educational Services) says DEC found that workers learned lessons 40 percent faster with interactive video systems in their own offices than they did if they traveled to Digital's training facilities and learned in traditional ways." (Strauss and Lentz)

"Learning a specific task takes an average of 30 to 35 percent less time with the disc than with other methods." (Lanier).

Learners using videodisc-based instruction remember more material and remember it longer than learners using traditional training delivery methods.

"Three times as many of the students who had the videodisc training passed as those who had taken the instructor based training." (Strauss and Lentz)

"On delayed post-testing, 75 percent of all videodisc trainees were successful; only 59 percent of the control group (classroom) students were successful." (Ebner) "Trainers generally agree that people retain about 25 percent of what they hear, 45 percent of what they see and hear, and 70 percent of what they see, hear, and do. Interactive video keeps the learner seeing, hearing, and doing." (Vocational Training News)

This third major benefit of interactive video is derived directly form the first and second benefits. Employer's training costs are reduced because each trainee requires less initial training time to master the learning material, providing more time available for the job. Because more training material is mastered by the learner, less remedial training is required (Strauss and Lentz).

A jet engine manufacturing plant figured that in the next 10 years, it might spend as a much as $14.1 million training its employees the traditional way. The total cost with interactive videodisc ($4.2 million) saved the firm $9.68 million. (National School Boards Association)

These findings are summarized below:

1. Reduction in learning time - master subject matter in 25-40 percent less time than traditional methods.
2. Increased learning - score 33-70 percent higher on mastery tests than individuals who use a traditional curriculum and technology (videotape or instructor).
3. Learning retention - performance retention after initial instruction is 20-40 percent greater than traditional instruction.
4. Training cost reduced
    a. less initial instructional time to master the learning material
    b. less remedial training is required
    c. longevity and durability of materials

Description of Demonstration

A partnership among a State Department of Economic and Community Development, a State Technical Institute, The University of Tennessee at Knoxville, and TVA was established to demonstrate a futuristic or state-of-the-art model training laboratory for technical skills. The laboratory containing a touch-screen interactive training system was developed to be used to train students in existing curriculum and area and State industrial audiences in "application-based" skills to complement the present "theory-based" instruction.

Major components of the instruction lab include:

- Three interactive work stations, each of which includes a touch-screen monitor, a laser videodisc player, a barcode scanning wand, a set of headphones, and the cables required for interconnection.
- Three sets of laser videodiscs which contain the following curricula and technical interactive library,

  Applied DC Fundamentals
  Applied AC Fundamentals
  Basic Electronic Components and Measurements
  Basic Electronic Circuits
  Basic Troubleshooting
  Advanced Troubleshooting
  Digital Circuit Fundamentals
  Digital Circuit Application and Troubleshooting
  Microprocessors
  Industrial Control
  Ladder Logic
  Introduction to Programmable Control
  Gould Modicon 584 Maintenance
  Industrial Hydraulics
  Industrial Pneumatics
  Gaging Practices
  Pre-Technical Study Skills - Reading, Mathematics

- Twenty sets of interactive workbooks which provide the written objectives, supporting test, calculations, progress checks, mastery exams, and the barcodes necessary for interaction with the videodiscs.
- Twenty sets of reference textbooks in electronics which enhance said interactive training. Each of the five textbooks in a set is cross-referenced to the respective training which takes place on the interactive system. Laboratory Manuals and Teacher Guides accompany the reference set, enabling the end user to schedule experiments on existing lab trainers and to adapt the more "theoretical" reference material to classroom instruction, respectively.

This technology allows one to five trainees to be on each of the systems at a given time. Therefore, an instructor could conduct a class of 20 persons simultaneously by interfacing the laserdisc system with a big screen monitor, or individuals could use unscheduled time to "loop back" in review or "branch forward" to preview further assignments in relation to their skill level by working in smaller groups.

The use of interactive touch-screen videodisc instruction is a significant new development in learning systems. This technology is exciting because of its enormous capabilities and the increased flexibility it brings to instruction systems. The key is implementation. Interactive videodisc training has four major advantages:

- Interactive courseware responds to the trainee, providing individually-tailored instruction at the right pace for the student. Training is flexible and can meet a wide range of development needs.
- Training is exciting, involving, and motivating for the student. Full-color graphics, live action video, and sound effects help relate the skills to the real work environment. Frequent question-and-answer check points provide immediate feedback on progress. Interactive courseware is the most dynamic, concentrated skill-building experience available.
- Study is made easy and efficient by the random-access capability of interactive courseware. A student who wants to check back on a specific topic can branch to it instantly, without distraction or wasted time. Interactive courseware is the world's most patient, consistent "instructor," providing unlimited opportunities to review and repeat.
- Training program labs are mobile to allow instruction to take place either in classroom or industrial setting.

Purpose of the Study

The purpose of the study was to document the processes and procedures used to implement touch screen interactive video disc methodology into an existing ongoing technical training program. The process evaluation made by The University of Tennessee was an attempt to; (a) document unusual problems that may be encountered when this new technology is implemented, (b) to suggest corrective actions, and (c) propose a model for implementing interactive video disc systems. While the project is only in the second phase, we have sufficient evidence that can be shared that will prevent others from replicating the same mistakes already made.

Setting of the Study

First, the setting of the attempted implementation should be clearly understood. The institution is a post-secondary technical institute that serves approximately 3500 day and evening

students. The Institute offers one year technical certificate programs as well as two year industrial and engineering technology associate degree programs. It provides specialized technical training to businesses and industries in a large geographic area of the State. The technical institute is involved in projects that are used to attract new businesses to the region. Additionally, the school offers remedial courses to students who have basic skill deficiencies. The technical program that attempted to implement the interactive video disc system is a one year certificate program in electrical maintenance. The program has been successful in preparing qualified industrial electricians.

Lately, the school is undergoing several major changes. It is in the process of changing from a technical institute to a community college, from the quarter to the semester system, and it has a new president, dean, and division head. The department which attempted to implement the interactive video system (IVS) has a new department head. One faculty member left but recently returned. Additionally, the demand for in-plant training has increased and two faculty members who ordinarily teach in the day-time program are assisting industries with their training during the day. This apparent problem left the program with one full-time instructor who was attempting to teach all of the lab courses. Students at various stages in their program were mixed together and several courses were scheduled at the same time. It is fair to say that faculty members were stretched too thin and carry very heavy loads.

These problems are not unusual but they did have a negative impact upon the school's success in implementing the system. An attempt to implement the system was done without prior planning. Again, this is not unusual when curricular changes are proposed and made. It is important to give you this background so you can keep these things in mind when the problems of implementing IVS are discussed.

In this case, the decision to implement IVS was an administrative decision. Faculty members were not involved in the decision to adopt the system and integrate it into their existing curriculum. They had the feeling that the system was being forced upon them and even expressed the view that IVS was being implemented instead of hiring additional faculty to teach in the program. Some instructional technologists express the opinion that IVS will reduce the need for more instructional staff. However, nothing could be further from the truth.

Unique Problems

One problem that was discovered that may be unique to implementing IVS into technical education is the problem with "ownership" and the limitations for making revisions. Generally, technical teachers have a feeling of ownership with "their" curriculum. Because they usually are the only teacher in the program, they are solely responsible for the building the curriculum. They must constantly up-date and revise instructional materials so they will remain current with new technologies. It becomes their program and they are in full command of its direction. Interactive video systems don't allow the teacher to change the content of the video disc. At most, teachers can omit portions or change the sequence of the programed offering. They can't change the contents to keep it current. This limitation will remain a problem until the technology evolves to the point that teachers can make changes and "adapt" the contents of IVS.

Implementing IVS is not the salvation for a floundering program that; (a) is not properly equipped, (b) has instructors who are not technically competent, (c) has a poor public image, (d) is not funded at a sufficient level, (e) is not competency based and uses individualized instructional strategies, (f) is having trouble teaching technical content required by employers, (g) has teachers and staff who are overloaded and do not have time to plan instruction, and (h) does not have administrative support.

Interactive video systems should only be implemented in quality programs that are wishing to use interactive video systems to supplement a competency based, individualized, and mediated (CBIM) curriculum. However, for the most part, IVS does offer quality and a highly accessible instructional methodology. Additionally, it has proven to be successful in reducing the amount of laboratory time for learning necessary technical skills. It is not a substitute for real-life applications and practice. It is not a system that can be adopted to improve the quality of the instructional staff. Instructors must first be technically competent and be highly organized.

We found that group methodologies were still being employed in the program and the IVS was simply being used to supplement and reinforce related instruction in an unorganized manner. In some cases, teachers were using the IVS system for large group instruction. Additionally, students were given assignments to use the IVS without complete directions. Students have had a difficult time finding the appropriate lessons. There was an inadequate reference index of lesson titles, workbooks, and discs. The curriculum was not in an acceptable CBIM format. While a list of competencies existed, no attempt was been made to organize learning activities utilizing IVS to meet the attainment of standards.

Implementing IVS is a time consuming task since it requires instructors to rearrange their instructional materials to accommodate an individualized format. Only instructors can satisfactorily do this task since they are responsible for writing the performance objectives, planning the sequence of instructional activities, i.e. assignments, applications, etc. and evaluating student performance. **Appendix A**, provides a format that has been used successfully in implementing CBIM. Clerical assistance and release time for faculty to complete this activity is a must.

The faculty were found to be technically competent but they were overloaded. The program was trying to accomplish too much with limited resources. Additionally, they lacked the

expertise in advanced methodology to successfully implement IVS into a CBIM format. In-service education for staff development is desperately needed and little progress will be made until this condition has been met.

The past and present administrators were not aware of the funding deficiencies that should have been eliminated. No additional funding was available for maintenance of the system, staff development, facility modifications, equipment, study carrels for IVS, release time for faculty, etc. Just purchasing the necessary equipment and software is not sufficient. Additional resources will be required to institutionalize IVS.

The quality of the IVS system was not what it should have been. Lessons appeared to be too brief, lacked depth, and were not associated with job requirements (standards). Additionally, the system was somewhat unreliable. Students and faculty had difficulty accessing the right materials at the right time. Errors were found in the programming and the system regularly defaulted without completing a "run." Students who had difficulty with the system, usually stopped and didn't ask for assistance since the instructor was not present. In the beginning, students were enthusiastic about using the IVS system. They were asked to go to another laboratory without direct supervision of their instructor. However, since the instructor was not present and the system was not reliable or well indexed, students quickly lost confidence in the system and preferred not to use it.

Of the three IVS units, two were placed on mobil carts so they could be used in different locations. One unit was permanently placed in the school's library. No special provisions were made within the laboratories or the library to accommodate the IVS systems. The views of administrators and instructors differed on where the preferred location should be. Administrators felt the ideal location was in the library and the instructors felt it should be in the laboratories.

Individualized instruction methodology, whether it utilizes IVS or not, requires a different facility than one designed for group instruction. Ideally, IVS should be housed in a "resource center" adjacent to the laboratory. Instructors should have visual contact when a student is using it and be available for assistance. Little time should be required to get to the IVS location and "centralized" locations are not satisfactory for apparent reasons.

In a resource center, that will accommodate several students at a time, head phones will be required. This is important so others around the system will not be distracted. Ear phones were available, but they were not used since the IVS was viewed by more than one student at a time.

IVS requires a highly documented index so that all of the IVS materials and discs can be properly stored and displayed. Specially designed cabinets are necessary to protect, file, and retrieve the materials. The index was less than adequate and no special furniture was used with the system.

Interactive video systems should not be purchased without vender support. While the vendor of this system had committed to support the system, the instructional staff were not made aware of it and how assistance could be obtained. It was apparent that the instructional staff felt alone in this effort. The school must obtain a written commitment from the Vendor that specifies their responsibilities that will keep the system operational and replace defaulting software and discs. Without technical assistance, what may be a minor problem will appear to be a disaster with this highly complex software and equipment.

The school's administrators were not aware of all of the problems associated with the implementation process. They felt the system was working well and was totally accepted by the faculty. Administrators must make a commitment to the system and to make sure they stand ready to assist if problems arise. They should be continuously informed about the

implementation process. A formative (process) evaluation system can assist with this problem. Immediate corrective actions can be taken to solve minor problems instead of waiting until they become major ones. Process evaluation will provide administrators and others with information of how well the system is being implemented. If used properly, additional support, encouragement, and needed practical alternatives will naturally take place. **Appendix B** is an example of a process evaluation form that could be used for this purpose. .

Required Conditions

Conditions that must be met to successfully implement IVS can be classified into categories. They are: (a) CBIM instruction format, (b) competent teachers in their technology and advanced methodologies, (c) additional funding, (d) quality IVS that is technically correct, (e) appropriate facility and location, (f) time release for faculty, (g) clerical assistance, (h) administrative support, (i) vendor support, (j) staff training, and (k) teacher acceptance. Additionally, the faculty must have a need to implement an IVS system and be motivated to make it work. Motivation will happen is there is a reward system and praise and attention is given them during the implementation phase. Removing rewards, funding, supporting staff, etc. will cause the IVS to disappear. If this happens, more traditional strategies will again take its place.

Implementing Change

Implementing change is a difficult and time-consuming process. It can be a painful process particularly if initiators fail to understand the dynamics of the process.

Implementing change involves three major phases: 1) **Initiation**, which leads up to, and includes, the decision to adopt the change, 2) **Implementation**, or initial incorporation and use (which usually encompasses the first two years or so), and 3) **Continuation** (or institutionalization), the phase where change gets built into the on-going program.

Unfortunately, the interactive video system (IVS) that we are reporting on has not been operational for a long enough period to have reached this third phase so my remarks today will focus on **Phase I, the Initiation** or adoption phase, and **Phase II, the Implementation** phase.

There is, of course, a **fourth phase** to this change process which we can call the outcome or results phase. Actually, it is the summative evaluation phase. At some point in time one must be concerned with what impact the change has made. In the case of the IVS one must eventually ask "Has it made a difference? Has student learning increased? Is the program more efficient in imparting course-related information? Are teachers and students more satisfied with the instructional program in its new format? Is it cost effective? and the like. It is clearly too early to monitor these results.

The total time frame from initiation to institutionalization is lengthy. It can take as much as 3 years or more. Consequently, change must be viewed as a process and not an event. That is a lesson that we typically learn the hard way. We invest all of our time and energy in the adoption process (the decision to proceed) without ever giving much thought to what should happen afterward.

Phase I: The Adoption Process

Support from Administrators/Instructors

Strong support and encouragement from school administrators is central to the adoption process. Administrators exert a great deal of influence, especially during the initiation phase. But they also can be equally powerful in blocking innovation. The message they send to other school personnel will impact significantly on the success or failure of the adoption/initiation process.

Whether the decision to innovate has been made in an authoritarian or participatory manner is also important to the subsequent success of the implementation phase. As Dr. Cheek mentioned, one of the mistakes that we think was made during the IVS adoption process was that there was little, if any, instructor involvement. Moreover, to date there is a clear indication that little thought has been given by administrators (or others) as to how the implementation phase will proceed now that the decision to adopt has been made. The result is that, at the moment, much floundering is evident.

Availability of External Resources

Availability of resources external to the institution becomes a powerful stimulant for adoption. This institution, like virtually all others, did not have the resources needed to undertake such a major curriculum change. However, in the case of the IVS an external funding source was found and this made the entire adoption process much easier.

Simultaneously, however, it may have created barriers to implementation because to date the institution has not committed any of its own resources to facilitate implementation. In fact, I would guess that it has failed to recognize that such funds are needed.

Institutional Orientation

Institutions are more likely to adopt innovations which promote the school's image as being "up-to-date", "on the cutting edge", and "responsive" to changing technologies. The IVS clearly had that "ring" about it. In fact, the potential publicity value associated with such innovative schemes probably influenced significantly the decision to adopt the IVS.

There are, of course, many other factors which impact on the adoption of new technologies such as the IVS. The quality and availability of "high tech" materials; the access to needed information during the decision-making

process; the extent of internal and/or external pressures for adoption; and whether the innovation is seen as addressing an important identified need will all impact significantly on the process.

Interestingly, the time line from awareness to adoption can consume the better part of a year but the time from the adoption decision to start up is usually quite short (a few months or less). Thus, once the decision is made things happen quickly. In fact, in the case of the IVS, things probably hap- pened too quickly. This left little opportunity for planning for implementa-tion. This has resulted in serious problems relating to inadequate instructor orientation and training; no release time to develop a management plan for the IVS materials, or to review the instructional content of the video discs or to determine how best to use the IVS. Yet to be determined is whether the IVS can or should be used as a primary instructional vehicle or as a supplemental tool to the traditional instructional program or perhaps some combination of these.

Phase II: The Implementation Process

Implementation consists of the process of putting an idea into practice. The processes beyond adoption clearly are more complex because they involve more people and real change (as opposed to "just an idea") is at stake. What people do, or do not do, with the innovative idea is the crucial variable. But people are much more unpredictable and difficult to deal with than things. Unfortunately, they also are much more essential for success. Consequently, we must constantly remind ourselves that educational change is a learning experience for all those involved (administrators, teachers, and students).

There are numerous factors which influence, and impact on, the implementation phase. The more of these factors that are working for us, the more success we are likely to experience.

Nature of Change

The nature of the change itself is related to subsequent implementation success. Does the innovation address a perceived need? If it does, it is more likely to be implemented; if not, it will be resisted. In the case that we are studying, there was agreement regarding the perceived need, but disagreement about whether, and to what extent, this IVS would adequately address that need. As Dr. Cheek has already mentioned, instructors viewed the adoption of the IVS as an alternative to hiring additional teaching faculty. Consequently, they have been somewhat resentful of, and resistant to, implementation.

There also is a need for clarity about goals, and means for implementation. At the moment, instructors are both unclear about expected outcomes and have seen no clear avenue for how implementation is to proceed. A heavy instructional load and a feeling among instructors that they have been left to "fend for themselves" impedes implementation efforts. Likewise, administrator apathy has led to a degree of frustration and anxiety among those charged with the implementation. It is as though administrators (who were involved in the adoption process) just "dumped" the IVS on instructors and said -- "Now you guys make it work". Sound familiar?

The complexity of the change will also affect implementation efforts. One of the major problems evidenced in implementing the IVS is that it is essentially a system which lends itself to individualized or small group instruction. But as Dr. Cheek has already mentioned, it was being implemented in a very traditional program which utilized large group instruction. That has compounded the problems associated with implementation. Had it been an individualized, competency-based program to begin with, implementation would no doubt have been easier.

The quality of the program also will affect implementation efforts. As Dr. Cheek has already mentioned, the IVS has several inherent "bugs" relating to accessing the right content, relating disc content to student workbooks, and the like. Given the fact that instructors have not been adequately oriented to the IVS, have received neither in-service training nor release time to plan how best to use the system, almost any difficulties encountered will lead to frustration and discourage instructor utilization. Frustration of this sort, of course, will lead very rapidly to abandonment.

Another factor impacting on the implementation phase has to do with the driving force behind the adoption process. If the decision to make changes has been carefully considered and has been well thought out, implementation is more likely to be successful. But if the decision to make changes is opportunistically driven (as is the case here), more serious problems arise.

Opportunistic adoption decisions generally are followed by limited implementation efforts. Teachers, who have not been involved in the adoption decision, become indifferent to implementation and administrators do not make serious follow- through attempts to provide resources, in-service training, or an atmosphere which is conducive to change.

Clearly, administrators set the conditions for implementation to the extent that they show specific forms of support and active knowledge and understanding of the realities of attempting to put an idea into practice. Failure to realize that there is a need for in-service training during implementation is a common problem. No matter how much advance staff development occurs, it is when instructors actually try to implement new technologies that they have the most specific concerns and doubts. It is the time when they experience the most trouble and the most frustration. Getting over this initial critical hump represents a major break through for true

implementation. At the moment, there is no evidence that administrators are addressing this issue.

One of the most serious problems is that administrators (decision makers for educational change) have an adoption time perspective, not an implementation one. Impatience, arising from the desire to bring about change results in hasty decisions, unrealistic time lines, and inadequate logistical support during implementation. Somehow they think change will happen by osmosis. It won't!

Administrators know the complexities of the adoption process; the instructional staff know the complexities of the implementation process. They live in two different worlds. Unless those two worlds are bridged, implementation of the IVS is not likely to occur. In our continuing work with this institution, we hope to help build that bridge.

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Appendix A

CBIM INSTRUCTION PLANNING SHEET

Code_____

Unit:_____

Task:_____

Lesson:_____

OBJECTIVE:

LEARNING ACTIVITIES:

RESOURCES:

Equipment & Supplies:

Appendix B

Date:_____

REPORT CONTENT
Activity
Planning
Progress
Other
(Circle One)

PROCESS EVALUATION REPORT

GOAL or OBJECTIVE:

Level of Accomplishment (CIRCLE ONE)
(1) Not Accomplished (2) Partially Accomplished (3) Accomplished

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If you did not accomplish what you had planned, what factors do you feel prevented you from accomplishing your goals?

Activity:

Comments:

School Personnel Reporting:

Signed by: